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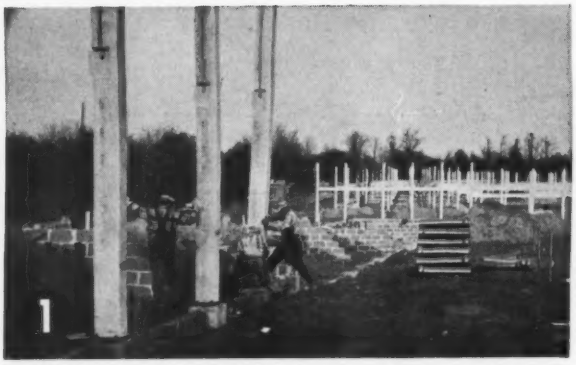
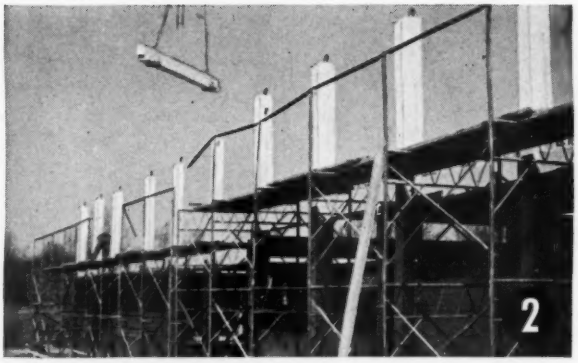
ROBERT E. WILSON

ENGINEERS AND ENERGY—PAGE THREE

Vol. 8 MAY, 1956 No. 12



First step was to erect the two-story precast concrete columns.



Next, the second floor spandrel beams were lowered into position.

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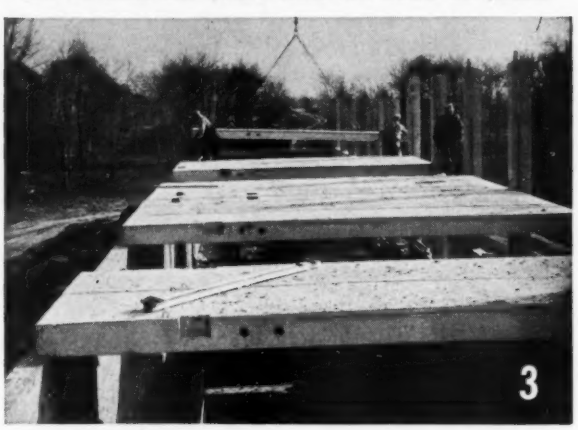
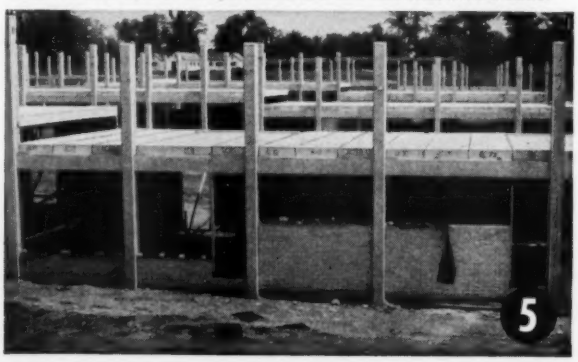


After rear walls were brought to second floor elevation, 3-ft. wide precast concrete floor channels with 10-in. legs were placed across the entire width of the buildings. Below is a view of the underside of the floor showing how conduits pass through sleeves in the legs.

General view before roof spandrel beams and roof slabs were erected.

Finished building. Precast roof slabs project 2 ft. to form sunshade.



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COVER STORY

Robert E. Wilson, 1956 recipient of the Washington Award, appears on this issue's cover. Mr. Wilson is chairman of the board of Standard Oil Company (Indiana). He is considered an outstanding corporation official, a highly distinguished scientist, and a statesman among industrialists. Please see pages 3 and 17 for more about the Washington Award.

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Engineers and Energy

By Robert E. Wilson

As one trained in a branch of engineering that has been added to the list relatively recently, may I compliment members of the four founding societies on the diligence, intelligence, rectitude, and other fine qualities that have made the term "engineer" so highly respected. Imitation is often said to be the sincerest flattery. If that is true, you gentlemen should indeed feel flattered, and your wives should be congratulated. Where we once had only four kinds of engineers — civil, electrical, mining, and mechanical—we now have many new kinds including: chemical, automotive, aviation, and so on.

Some of the new branches are quite logical, and so engineers need not feel unduly flattered that their title has been adopted. It is stretching the term a bit, however, when we start having "management engineers," "sales engineers," and "traffic engineers."

A slight break in the nomenclature was necessary when some of those engaged in designing furniture, equipment, and work space decided to call this activity "human engineering." The people who practice human engineering apparently hesitate to call themselves "human engineers," probably lest it be inferred that other engineers are not human. Or the ministers might begin calling themselves divine engineers. It may well take one to get some of us into heaven!

Today the term "engineer" is being adopted or usurped for a wider and wider variety of activities. We may yet see the day when chefs are "food engineers," with subdivisions for "salad engineers" and "hamburger engineers." A recent *New Yorker* cartoon showed a distraught cook surrounded with all the modern gadgets in an electric kitchen, and a framed electrical engineering diploma on the wall.

Television comedians may become "laugh engineers"—and with a good deal of justification. Certainly some of their humor is both contrived and mechanical.

On the whole, I think usurpation of your name has gone too far. Engineers may have to take steps to restore the prestige that made that name so popular in the first place.

One possible solution might be to follow the trend toward double names, pioneered by the tautological Esso Standard Oil Company. Real engineers might start calling themselves "engineering engineers." Needless to say, such engineers would confine themselves to the log log scale on their slide rules. This all may sound a little fanciful, but I am told that a prominent engineer at Ford once actually held the title "Chief Engine Engineering Engineer."

For true engineers another good descriptive title would be "energy engineers," because that is what most of them really are. The basic job of the major branches of engineering is to develop and use the best means of applying energy to the work of the world. Even chemical engineering is largely concerned with handling heat and chemical energy.

As we look at past civilizations, we see that the greatest marvels—in some cases about the only great marvels—have been the things that prehistoric engineers accomplished with the relatively small amounts of energy they had available. We see such things as the Pyramids; the stone images on Easter Island; the great monolithic columns in Peru; and temples now buried in the jungles of Indo-China.

The high stone aqueducts of Rome brought to the city more water, per person, than is enjoyed by many modern cities. Those aqueducts illustrate an important point. Long before they were designed, attempts had been made to use pipelines for carrying water down one slope of a valley and up the other side. The pipes were made of wood, brass, and terra cotta. They failed because they were not strong enough to stand the pressures.

If the Romans had put some time on engineering research and had developed materials of construction satisfactory for pipelines, they would have saved the enormous amount of labor needed to build the aqueducts. Moreover, the new construction materials would have had other uses. And research itself would have got a start. Perhaps the Roman engineers would even have solved the empire's economic and other problems, so that Rome would not have fallen. The thousand-year halt in progress we know as the Dark Ages would not have occurred, and we might now be enjoying the civilization our descendants will enjoy in the year 2956!

The Change from Muscle Power

While it would be fun to figure out what the world will be like ten centuries hence, it would be indeed an imagination-staggering task—especially if we tried to extrapolate from the rapid rate of change in the past century.

One of the most startling changes, thanks to the efficient work of engineers, has been in the way man's physical work is accomplished. One hundred years ago, 94 per cent of the work in our country was done by the muscles of men and animals. Only 6 per cent was done by other sources of energy. Today, the situation is exactly reversed. Less than 6 per cent is now done by muscle power; the other 94 per cent is performed by the *tireless* forms of energy.

Moreover, the total amount of energy available to each person is much larger. We have not simply turned over to coal and oil the work formerly done by oats and hay or by meat and potatoes. We have thought up many new jobs, and we have found the energy necessary to do them.

There has been improvement in still another way. Thanks again to the engineer, we are able to do more work per unit of energy. The diesel locomotive does about five times as much work per Btu as its predecessor—a device some of the older people present

Mr. Wilson, recipient of The Washington Award for 1956, is chairman of the board of Standard Oil Company (Indiana). He presented this Washington Award Address before the Western Society of Engineers on May 1, 1956 in Chicago.

may dimly remember, called the steam locomotive.

There are other, less obvious, ways in which present use of energy is more efficient. Most, though not all, of the improvement in the output of automobiles is due to higher compression ratios, made possible by fuels of constantly improved antiknock properties. During my own service in the industry the average octane number of gasoline has gone from about 50 to about 95—incidentally at staggering cost to our industry—for which we get little credit. Everyone can see the tremendous changes in the automobile. However, despite the fact that about 70 per cent of our present-day motor gasoline consists of synthetic molecules not present in the crude, gasoline looks the same, smells the same, and only a high-compression engine can really tell the difference. A substantial amount of improvement is also due to better engine design. Better lubrication has also helped.

Continued study by engineers has likewise decreased the energy required in most forms of industrial processing. For example, such things as metal working require much less energy than formerly.

Many of these improvements have been substantial. In some cases the improvement factor is as much as 10.

In addition to the increase in efficiency, we must also remember the increase in convenience. Diesel locomotives are not merely more efficient than steam locomotives; they are also smoother and cleaner. And many of our modern devices give results that could not previously be achieved at all. In 1856, if you were in New York and wanted to be in London the next day, there was no way you could do it, no matter how much energy and money you were willing to expend.

This factor of convenience is one reason why the number of internal combustion power plants has grown enormously. Today the combined rated horsepower of the Otto cycle and diesel engines in the United States is about 80 times that of the central power plants using steam! Of course, most of the internal combustion engines are operating only part of the time, but some of them—such as diesel locomotives and the diesels used in central power plants—have rather high operating factors.

Certainly we can agree that engineers have done a good job in helping us get the most possible service out of the increased amount of energy we have had available, and in developing new devices to use energy for the benefit of man.

Past Sources of Increased Energy

In view of this revolution and the great increase in use of energy, it is interesting to review the sources of these increased supplies. The story is particularly interesting if we look at the past fifty years. During that time a major change in the pattern has occurred.

At the turn of the century the statistical information was none too accurate, but best estimates are that the burning of coal provided about 70 per cent of the energy supply of the nation. The burning of wood provided about 20 per cent. The remaining 10 per cent of the energy market was divided between oil, gas, and water power.

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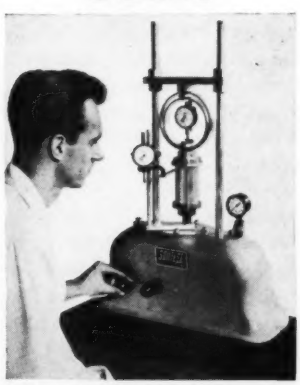

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gas had grown to about 15 per cent of the total. Today they supply about 65 per cent of the country's energy. Coal's percentage has faded, and wood has been almost eliminated. Even water power, with all the government aid, has declined in percentage as against either 5 or 10 years ago. Although we have a larger population than in 1918 and use much more energy per capita, the country's coal tonnage has actually decreased.

Engineers have contributed much to this increased supply of oil and natural gas. A list of the things for which our industry must thank engineers would include:

First, improvements in well drilling — from the development of rotary drilling itself to such special items as directional drilling. Out in the Gulf of Mexico as many as ten different wells can be drilled from a single platform — but the platform itself may cost around a million dollars, and the auxiliary equipment even more.

Second, better production methods, which increase recovery through a whole new science of reservoir engineering. Of increasing importance are the secondary recovery methods: water flooding, gas drives, use of surface-active agents, and other new techniques. Old methods frequently recovered only 20 or 30 per cent of the oil. Secondary recovery may well double the amount recovered from many fields.

Third, low-cost transportation, especially by pipeline. Engineers have not only developed very efficient pumps and drivers, but also machines to dig the ditches and assist in many stages of pipeline construction. Oil products in America go from well to refinery to terminal to consumer by an integrated transportation system at an over-all transportation cost averaging only 3c a gallon for a 1000 mile trip.

Fourth, refinery engineering, another new branch of your profession. It was made necessary by the advent of thermal cracking — a high-pressure, high-temperature process. Refinery engineering met that challenge and then went on to make possible many other new processes, notably those of the catalytic revolution.

Through these and many other contributions, engineers have given us more and better energy-producing liquid fuels at amazingly low cost—which is why they have been growing so much faster than other fuels.

Future Energy

However, to an engineer I am sure the most interesting question is how our future energy needs will be supplied. Certainly few believe that the accelerating curve of energy use will flatten off soon.

The problem of future growth, however, is by no means as easy as it has proved to be for the past 50 years. For one thing, since the turn of the century the efficiency of central power plants, automobiles and locomotives have all been more than doubled, and no such major gains seem possible in the future.

Nor is the problem to be readily solved by the coming availability of nuclear energy. Some uninformed people seem to think that nuclear energy will soon do to oil what oil has done to coal. Nuclear energy is not yet even as cheap as coal, and for most purposes seems unlikely ever to be as convenient as oil.

Speaking before a technical group, I hardly need point out that nuclear energy will probably never supplant liquid fuels for mobile equipment smaller than ocean-going vessels. Atomic locomotives are a remote possibility, but atomic automobiles seem entirely out of the question. Among the difficulties are, of course, the danger; the need for shield-

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ing; and the high cost of any probable atomic engine, as compared with the $300 engine that drives most of our automobiles.

The only use of oil likely to be displaced by atomic energy within the next few decades is that of residual fuel oil in central power plants, but coal may well displace most of such oil before atomic energy does. In addition to central power plants, the chief users of residual fuel are: ships; the railroads; industrial plants; mines; and space heaters. Taken all together, such equipment now consumes residual fuel amounting to less than 15 per cent of our refinery runs of crude oil. During the last ten years we have cut the yield of this low-priced product from 25 per cent to 15 per cent, mainly by more coking and cracking. We look forward to converting most of the rest of it into gasoline and other products by known methods, and at costs considerably lower than the cost of making gasoline from coal or oil shale.

The main supply of liquid fuels that we definitely know about is of course that contained in our proven reserves of petroleum. These now amount to a little more than a twelve-year supply. This may sound like an alarmingly small proven reserve, but things are not really as bad as they sound. Certainly it does not mean that in twelve years we will run out of oil. More oil is being discovered every day, though it is gradually becoming harder to find. Almost without exception, the new oil found each year has exceeded the year's production. So, our proven reserves measured in barrels have continued to grow year after year. Our demand, however, has also grown.

If we look at the record over the years, we find that the ratio of proven crude reserves to annual production has been nearly constant ever since the American Petroleum Institute began making annual estimates of such reserves in 1936. Thus, reserves were about 12½ times production in 1936, about 12½ times production in 1945, and about the same ratio now. A drop below that figure apparently stiffens prices and provides additional incentive to increase the search for oil. When reserves rise above that figure, there is less incentive to drill wildcat wells and wells aimed at extending the present fields.

However, we must admit that the easily found oil has already been discovered. Wildcats must be drilled deeper and deeper to find oil. Cost goes up because of three factors: the greater number of feet drilled per well; the increased cost per foot at great depths; and today's general increase in the cost of everything. When you add those three items together, you see why wildcatting costs are soaring.

New Oil Fields

Yet I think we can look forward confidently to continuing discoveries. As we look at past estimates of ultimate, rather than proven, oil reserves, we find that they have always been too low, some of them spectacularly so. In 1885 the United States Geological Survey stated that there was little or no chance of getting oil in California. Since that date over 8 billion barrels of oil have been produced in that state. In 1892 the United States Bureau of Mines estimated that the total future production of the country would be only about 5,700,000,000 barrels. Since 1918 alone we have produced 48 billion barrels, and our proven reserves today are at 30 billion.

In 1920 the director of the United States Geological Survey said: "The United States needs foreign oil and synthetics. Peak domestic production is almost reached." But in 1955 this country's production was more than five times what it was in 1920.

(Continued on Page 18)

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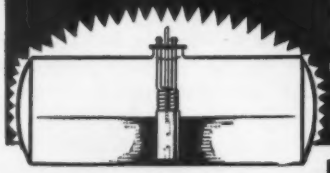

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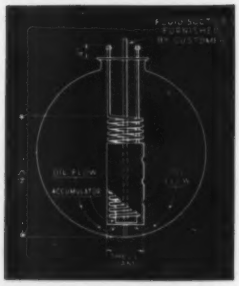

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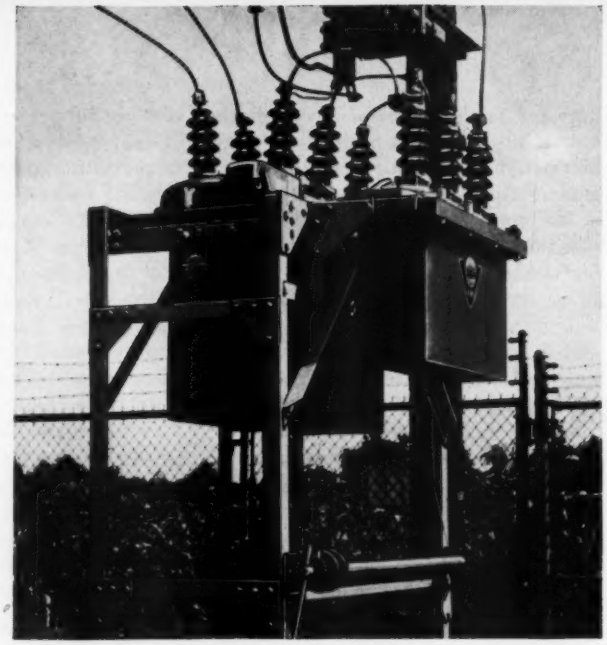

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The Messina Strait Suspension Bridge

By Mario Palmieri, MWSE

Bridges are designed and built whenever and wherever the need arises of spanning a body of water which constitutes a hindrance to the social, political, industrial, or economic development of a region.

Such a need exists nowhere as strongly and as impellently as in Italy, separated from Sicily by the Strait of Messina.

Actually, the Strait of Messina is a straitjacket that stifles the life of Sicily, an island that is practically a subcontinent, covering, as it does, almost seven million acres, and peopled, as it is, by nearly five million inhabitants.

Through the Strait, conveyed by an antiquated system of ferry-boats, flows a railroad passenger and freight traffic, that amounted last year to 5,000,000 passengers and 600,000 railroad cars.

The exportation of the whole citrus fruit crop, the transportation of crude oil, being now produced in continuously increasing quantities as new oil fields are being added to the ones already in operation, and the outflow and inflow of all the other items of the industrial and economic life of Sicily, depend thus on a ferryboat system that has reached the limit of its potentialities.

Problems Inherent to the Bridging of the Strait

Since time immemorial people have dreamed of connecting Sicily to Italy, spanning the Strait with one type of bridge or another.

However, only the most recent advances in suspension-bridge engineering have made finally possible the realization of that dream. For the problems inherent to the bridging of the Strait can be solved only by the combination of the scientific engineering, and technical knowledge gained in the last hundred years.

To begin with, at no place in its median part, is the bottom of the Strait less than 350 feet below the mean water level.

There the Strait is a channel for the inflow and outflow of a swift marine current between the Ionian to the Thyrrenian seas.

Furthermore, winds of a velocity of 100 miles per hour are common, and, finally a seismic fault, running longitudinally through the Strait, is a potential source of major earthquakes, constituting, as it does, a plane of least shear resistance along which are bound to take place all movements of the earth's crust.

To these problems deriving from the geographic and geologic conditions of the Strait, it is necessary to add the problems deriving from the amount and the nature of the traffic to be convoyed.

The bridge must carry both railroad and highway traffic. The amount of railroad traffic is presently known, and the future increase can be safely predicted. The amount of possible or, at least, probable automotive traffic cannot be predicted. The ferry-boats now in service are able to carry only a few autos at each crossing, therefore, present automotive traffic cannot be used as a guide for the future.

Last, but not least, of the problems inherent to the construction of the Messina Strait bridge, is the economic one.

The Messina Strait bridge must be economically self supporting if it is to be built at all.

The Messina Strait bridge must therefore be financed by bonds redeemed through toll revenues. Having estimated the cost of construction, the total cost of the bonds, the period of amortization, and, of course, the traffic the bridge will carry, it would be an easy matter to specify tolls to be charged to net the required income. Complicating this, however, is the fact that tolls cannot be higher than present ferry charges. The bridge must be designed, therefore, with an eye to the final estimate.

Preliminary Work of the Italian Navy

The Italian Navy proceeded during the summer of 1955 to a determination of the depth of the Strait of Messina by taking soundings throughout the area to be covered by the bridge crossing.

As a result of this work, there was definitely established a line which pivoting from "Punta Pezzo" on the Italian coast met on a bearing of 308° N.W. the Sicilian coast near the village of Saint Agata.

On this line there exist, perfectly aligned, and perfectly symmetrical, at 1,150 meters apart, three plateaus adequate for the foundation of the three main piers.

The work of the *Staffetto,* the Italian ship, has vindicated then the belief of all those who have staked their reputation on the claim that the Strait of Messina can be bridged, and that it can be spanned by a suspension type bridge.

The Design of the Bridge

The bridge span resting thus unequivocally determined, the designer thus has the responsibility of fitting the bridge to the geographic condition. Fortunately, a suspension bridge of this type is the best answer to the problem of designing a structure of adequate rigidity to serve both railroad traffic and highway traffic. Most large-span suspension bridges are highway bridges. The Messina bridge, in addition, will be subject to the passage of long and heavy freight trains, driven by two locomotives weighing as much as 350,000 pounds each. Last year the Italian railroads ferried across the Strait 6,000,000 tons of freight and nearly 5,000,000 passengers. The words "ferried across" were purposely stated because the crossing of the Strait is now done by ferry-boats used mainly for railroad traffic. Few automobiles are ferried across.

The designers of the present bridge, conscious of the tremendous development that will probably take place in automotive transportation across the strait, once the bridge is open to traffic, have provided for a double-deck structure, relegating railroad and heavy truck traffic to the lower level and other automotive traffic to the upper one. They have provided thus six lanes for automobiles, two for motorscooters, and two for bicycles within a width of 123 feet. Twenty of the 123 feet, however, will be left open to provide a longitudinal slot

Dr. Palmieri, the author of this paper, is chief engineer of the Messina Strait Bridge Corporation of America.

running through the full length of the bridge. This longitudinal slot is considered the best provision for the stability of the bridge against the effects of the wind. But the bridge itself, with its high ratio of dead load to live load, with the double central spans, with the box shaped transverse section, with the double system of lateral bracing provided, and with a coefficient of rigidity as high as 1480, among other features, will be, it is considered, as stable to the aerodynamic effects of the wind as can be made.

The Messina Strait region has experianced earthquakes of an intensity as great as that represented by Number 10 of the Seismic Scale Rossi-Forel. This means that the bridge may be subject to a horizontal force, applied to its center of gravity, equivalent to one-tenth of its dead weight. The double lateral system of horizontal bracing has been designed to take care of this force as well as the horizontal component of the wind.

An interesting feature of the bridge design is constituted by the Vierendeel Trusses used as main transverse frames of the bridge.

The railroad cars and heavy trucks, carried on the lower deck, will pass through the rectangular openings of the Vierendeel Truss.

The bridge will have four cables instead of the usual two, which, in this case, would have been of an entirely too large diameter.

The Foundation Problem

The foundations of the three main piers must be laid in water 350 feet deep, subject to the action of fast currents, in a Strait which cannot be closed to traffic for more than a few hours at a stretch.

The system used for the Mackinac Bridge foundations was first considered for the Messina Strait Bridge, but a more original system was developed by the author. Taking advantage of the drilling facilities of the French Company, Benuto, and of the Intrusion-Prepakt process, used successfully in the recent building of the radar islands, commonly called "Texas Towers," the foundations will rest on small circular caissons brought down through the overlying strata to bedrock.

It is believed that this system will eliminate all the hazards deriving from the handling of large caissons such as those used for the Mackinac Bridge.

The Economic Financial Problem

The revenues that will be used to finance the bridge will come from two main sources: railroad traffic and automotive traffic.

The Italian railroads are government owned and the tolls they pay, therefore, might be considered a contribution by the Italian Government.

There is good reason to believe that the International Bank will capitalize this contribution as an outright loan, making possible the issuance of bonds to cover only the part which is to be financed through tolls imposed on automotive traffic.

Automobiles now being ferried across the Strait cost as much as eight dollars and trucks as much as 28 dollars for the round trip.

Allowing for substantial reductions in such rates, it will be possible, it is believed, to adjust the automotive toll charges to the volume increase of traffic so as to obtain enough revenue from this source of income to warrant the issuance of 25-year bonds for the remaining financing cost.

The bridge will cost 200 million dollars. This is not considered excessive since its size and the difficulties of its construction will be so great. Preliminary plans are being presented for approval of the Italian government as this article goes to press.

Following this approval, the machinery will be set in motion to proceed with the borings, already planned to take place in the summer of 1956.

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Volume Reports on Soviet Professional Manpower

The volume, *Soviet Professional Manpower*, represents a study of the educational system of the Soviet Union as it relates particularly to the training of scientists and engineers and as it relates to science as a part of the curriculum at the various levels and types of training in the Soviet Union.

The work was undertaken by the Office of Scientific Personnel of the National Academy of Sciences-National Research Council in the spring of 1952, the preliminary research being carried out by Mr. Boris Gorokhoff of the Library of Congress. The final research and writing was done by Mr. Nicholas DeWitt of the Russian Research Center at Harvard University, and the publication of the volume was financed by the National Science Foundation through the Government Printing Office.

This volume not only breaks new ground in that it is probably the most thorough and complete study by far of any phase of Russian education, but it will probably remain the standard work in this field for some time to come. Much of the most significant information, such as the rate of training of scientists and engineers and related items, has been current for some time, since the information was deemed of importance for national policy and has been freely disseminated during the course of the study.

However, the information with respect to the school system as a whole is mostly new to the American public and of high significance in a world in which international competition is still rife and where technology constitutes the sinews of both economic and military struggle.

Perhaps the Russian philosophy with respect to education which is made clear in this study is one of the most significant matters discussed. From the very first days of the Revolution every effort has been put forth to make public education and especially training in the sciences and engineering a central purpose of the Russian State. This is based on a realization of the role of technology in economic and political power. However, the emphasis on education and training is wholly in terms of the needs and desires of the State rather than of the individual. There has been no deviation on this point from the first.

It is interesting that during the formative years of the Soviet Republics up to 1931 specifically, the original Bolshevik philosophy of emphasis on the proletariat was reflected in an attempt to increase greatly the percentage of youth from the working classes entering higher education. By 1931, however, it had become apparent that many of the philosophies propounded were incompatible with solid academic preparation. Consequently, beginning in the early '30's the school was completely made over with traditional discipline and traditional dependence on quality of work as criteria for advancement and other steps to strengthen greatly the effectiveness of the training in the schools. One of the results of this new emphasis is that a highly disproportionate percentage of the youth going on to higher education arises from the managerial and professional class at least comparable with the situation in the western countries.

A second emphasis which has characterized Russian educational institutions from the first and which continues today is the heavy emphasis on technology and basic science instruction. Even in the elementary grades 1-4, inclusive, 28%

This review of the volume "Soviet Professional Manpower" is by M. H. Trytten, director, Office of Scientific Personnel, National Research Council. The review is reprinted from the Engineering and Scientific Manpower Newsletter, No. 87.

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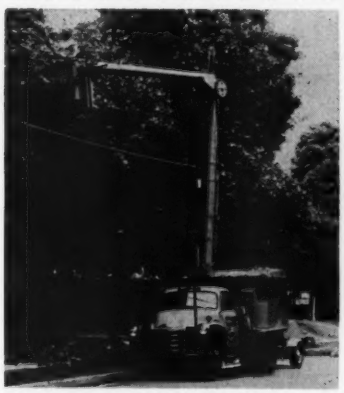

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of the subjects would be included in the general category of mathematics and science. In the intermediate grades over one-third of the time is spent on such subjects and in the upper grades in the secondary schools over 40% of the time is spent on the sciences and mathematics. Some familiarity with physics and chemistry begins as early as the sixth grade. The result is that upon graduation from high school all of the students, not only those electing to go on to higher education in the technical branches, have substantial training in and familiarity with physics, chemistry, mathematics, and the earth sciences. It will be noted that later also this emphasis is not only reflected in the curriculum, but is reflected in various selective devices which channel the ablest youth into the technological branches.

In view of the considerable concern expressed in the United States recently over the shortage of teachers, it is interesting to note that consistently attention has been paid to the student teacher ratio in Russian schools. In 1940 there were 28 students per teacher, but in 1950 the student teacher ratio had been reduced to 23 to 1. It seems most probable that this ratio will still further be reduced by the exact reverse of the situation which is producing the crisis in America, namely, that Russia is facing now the results of a drop in birth rate during the war because of the direct effect of invasion, whereas America is facing the effects of a rising birth rate during the same period.

Perhaps the major difference between Russian education and that in the United States lies in the heavy emphasis on the type of training represented in America by technical institutes. There are in Russia the order of 1,500 such "technicums" which give a type of instruction generally above the high school level, but not aiming for professional competence in the sense of our engineering schools. These technicums offer training not only in the engineering and science fields but also in medicine, pedagogy, law and agriculture. Generally, heretofore, admission into the technicums has been highly competitive with anywhere from three to five for each opening and has been at the end of the seven years of elementary instruction. The courses generally have been four years in length. However, more recently the competition for entrance has been such as to lead to higher and higher selection of those admitted from persons with partial or full attendance at secondary schools. It seems probable, therefore, that before long the technicum entrants will be recruited largely from persons who have the benefit of full secondary education.

The training in these technicums is substantial and has a far greater theoretical content than is the case in American institutions and the individual enjoys several periods of practical experience in industry. The rate of graduation has been substantial and most recently has been of the order of 60,000 per year in the field of engineering alone.

It seems clear that the heavy dependence on this kind of institution in Russia arises from the fact that the youth in Russia as a whole have had practically no experience in their earlier years with machinery of any kind and formal education, therefore, takes the place of the sort of experiences which American youth gather from daily living in a highly technical society. Nevertheless, the quality of instruction appears to be sufficiently high so as to be most significant in the development of Russian industry.

With respect to the institutions of higher education, the same emphasis in the same trends are apparent. Every effort has been made over the past decades to strengthen training in these institutions and in the engineering and industrial fields alone there are about 177 institutes for technological training associated with technical schools. This does not include the scientific training given in the thirty-three Soviet universities which are largely hold-overs from the pre-Revolutionary times and which are similar to the typical European university.

Soviet engineering training is characterized particularly by the long hours, the full weeks, and a substantial part of the year which is spent in actual attendance at class, all of these greater than in corresponding situations in the United States. There is, therefore, an intensity which is greater than is characteristic of American institutions. There is also a heavier concentration in studies re-

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lated directly to the individual specialization. Thus in an engineering curriculum only 6-8% of the time is spent on political and socio economic courses. These can more probably be called indoctrination courses. Over a quarter of the time is spent on the general sciences and another quarter of the time is spent on general non-specializing engineering. The narrow specialized engineering takes the rest of the time, with the exception of 6-10% of the curriculum devoted to physical training and military instruction.

The polarization of the flow of students towards the physical sciences and engineering is a recognizable characteristic of the Russian system. This arises partly from the fact that the adulation of the scientist and engineer in Russia, his social acceptance and somewhat greater freedom from ideological pressures make this an attractive way of life, as well as one that is likely to be somewhat more remunerative than others. Furthermore, the laws respecting military service have a similar effect. The draft becomes effective at age eighteen. However, the brighter and abler students generally finish their secondary training well before the age of eighteen and are able to enter the university and establish themselves as students prior to reaching military age. Thereupon the general deferment of students at the universities takes effect and the individual is permitted to finish his university training. After completing his university training, he may be, and probably is, in most cases, exempted from military service to enter specific technological posts related to the needs of the State. Thus the military responsibilities of the individual also make it more attractive for him, if he is so inclined, to take up his studies in the technological branches.

Much has already been said about the numbers of persons graduating in the technical fields and this does not need to be repeated here, except to say that the numbers are on the increase. It should be pointed out, however, that this does not mean that training at the university level in all branches exceeds that in the United States. In the general fields of the humanities and social sciences and in the liberal arts training, which is essentially unspecialized, the numbers in the United States greatly exceed those in Russia.

However, the high degree of polarization above referred to means that the numbers studying and being graduated in the technological areas are, and probably will be for some time, greater than in the United States.

There are thoughts which occur after a study of this kind which raise the question as to what these developments in Russia may mean in the future. The one characteristic which seems above others to be likely to weaken the Russian technological effort is the very high degree of specialization and the very large number of specialists in the scientific and engineering fields. It is entirely possible that the high degree of specialization may carry with it a lack of flexibility or adaptability such that the individual, if displaced from his immediate specialization, may become considerably less useful, if not frustrated entirely. This is, of course, a greater danger the less able and versatile the individual is in himself. In view of the high degree of selection in the Russian educational system, it would be expected that many of those in these fields would have a sufficiently able mind so that this may be less effective. Nevertheless, it does represent one of the possibilities that may limit the effectiveness of Russian technology.

One also wonders whether in the long run this high degree of dependence on education may not be the influence which may represent the strong possibility of significant changes in the Russian philosophy. The human mind does not always remain in the grooves in

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which it has been trained to run and the greater the ability of the individual and the higher the degree of training to which he has been subjected, the more likely is it that his mind will function independently. There seems reason to suppose, therefore, that the greater the emphasis on education in Russia, regardless of the nature of that education and training, the more likely it is that in the long run many of the minds in Russia will be sufficiently emancipated so that slavish acceptance of the Russian philosophy will be impossible. It will be interesting to see whether this phenomenon does occur.

On the whole, the volume represents a study which is challenging in its significance and should be the concern of American educators, whether primarily interested in technological education or education in general.

Table Rock Dam Is Proving Ground

Table Rock Dam in Missouri is fast becoming a proving ground of revolutionary ideas, according to *Construction Methods and Equipment*, McGraw-Hill publication.

Workers on the $70,000,000 project are pouring 7½-foot concrete lifts, a radical departure from the standard five-foot design, and are operating a closed-circuit television system to aid in dumping concrete buckets. Among other innovations that may set the pace for future dam building are remotely controlled bucket openers, and pre-cooling in silos of the aggregate needed for making the concrete.

The dam is only 25 per cent complete, but its giant monoliths already tower high above White River, where it cuts through the heart of the Ozarks. Pioneering the new methods is a joint-venture firm with a $24,000,000 contract which calls for placing 1,300,000 yards of concrete in a 1,600-foot dam, and 3,300,000 yards of fill in a 4,800-foot embankment.

Top feature of the job, the 7½-foot concrete lift, virtually untried in this country, means a third less form handling, the magazine says. Rugged box-truss cantilever forms, developed especially to contain the high lifts, resist deflection, a critical factor on the sloping upstream and downstream faces of the dam. The form is made in two identical sections: the lower panel is anchored to two lower lifts, and can be released without disturbing the upper section; top panel for downstream face hinges back to permit close concrete dumping.

Two usual bottlenecks of dam-building—picking up and dumping the buckets of concrete have been eased by use of a closed-circuit television set. The cableway operator sits in a self-propelled tower which rides the same tracks as a bucket-carrying railroad dinkey. From this tower, the operator can watch the bucket as he lifts it. When he is ready to move it out to the dam, he raises his eyes to a television receiver mounted overhead, and sees the cableway hoist pulleys nearly a half mile across the river. By watching the pulleys on TV, he can coordinate the simultaneous traveling and lifting of the load, the magazine says.

Speeding the discharging of buckets still is a problem—a worker must attach a compressed-air line to the bucket to open it, a slow and dangerous process. But testing of a new bucket, which includes an automatic opening system will begin soon. The bucket will be opened when the concrete is to be dumped at the batch plant merely by triggering the cover with a hooked pole. This device in turn may be replaced by a remotely controlled radio system, the magazine says.

On Reputation

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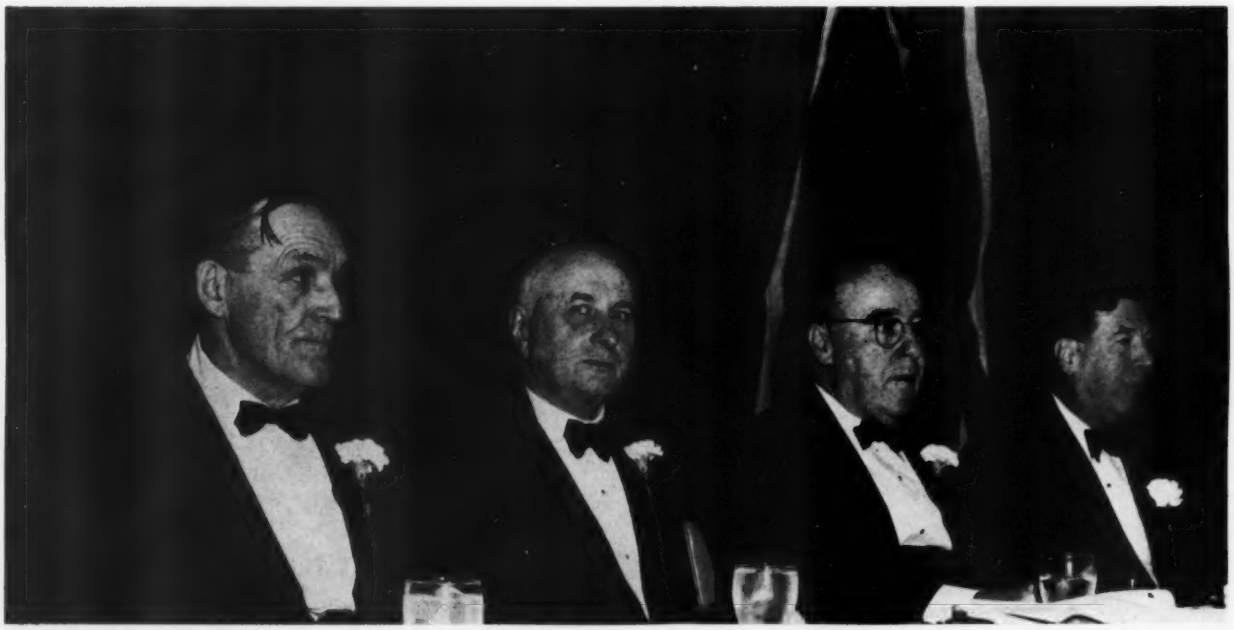
Above (left to right), Ray D. Maxson, Robert E. Wilson (recipient), and Albert P. Boysen



Above (left to right), Ben G. Elliott, Andrey A. Potter, Robert E. Wilson, and Ray D. Maxson.

Robert E. Wilson Receives Washington Award for 1956

Mr. Ray Maxson, (MWSE), a member of the Washington Award Commission, called the 33rd award meeting to order on the evening of May 1, 1956, at the Furniture Club of America, in Chicago.

He then gave a short history of the award, explaining that it had been founded 40 years ago by John Watson Alvord, a member of the firm of Alvord, Burdick & Howson, and a past-president of the Western Society of Engineers.

Mr. Maxson went on to explain that during this 40-year period the Washington Award had been conferred on 32 distinguished engineers and scientists, the first award being conferred on Herbert Hoover. The list of recipients, Mr. Maxson pointed out, represented persons of a broad field of interests, and from both near and far.

"The Award," Mr. Maxson then continued, was "made pursuant to a recommendation by a commission composed of 17 members representing five engineering societies, namely, the American Society of Civil Engineers, American Institute of Electrical Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the Western Society of Engineers." The Western Society, Mr. Maxson explained, administers the award.

He went on to point out that the commission in addition to selecting a recipient of the award for the current year, also prepares a list of eligible candidates for the use of the commission the following year. He invited the persons at the meeting to submit the names of nominees.

Continuing, Mr. Maxson said that there "are many kinds of engineering and scientific awards and it is quite appropriate that there should be, to honor those who have done outstanding work in their respective fields and thus gain the recognition due them. I think the Washington Award is particularly appropriate for the engineer as, in keeping with the idea of the founder, it is for accomplishments which preeminently promote the happiness, comfort, and well-being of humanity . . ."

Mr. Maxson next introduced some of the previous recipients of the Washington Award who were seated at the speaker's table. He also introduced Mr. L. R. Howson, a past-president of the Western Society, who responded for all participants in the award.

Some of the many qualifications, and the philosophy, of Dr. Robert E. Wilson, the 1956 recipient of the Washington Award, were then commented on by Mr. Maxson. The recipient's wife was then introduced and asked to stand and take a bow for the encouragement and understanding she had given Dr. Wilson over the years.

Mr. A. J. Boysen, president of the Western Society, then presented the token of award to Dr. Wilson.

Dr. Wilson responded with his address (reprinted in this issue of *Midwest Engineer* starting on page 3).

At the conclusion of the address Mr. Maxson spoke his closing remarks. He then adjourned the meeting.

Above (left to right), Albert P. Boysen, Louis R. Howson, Thomas M. Niles, Carl H. Samans, and Robert Gear

Engineers and Energy

(Continued from Page 7)

As a matter of fact, even the industry experts have been too pessimistic in their forecasts. Every few years during the past thirty some group or committee has attempted to forecast the trend of oil production in this country; every one has concluded that the steeply ascending curve cannot continue, but must soon flatten off and probably reach a peak in ten or fifteen years; but, fortunately for us all, everyone has soon been proven wrong, and there is as yet not even a sign of flattening.

There are many new areas in which we shall undoubtedly find additional sources. The tidelands represent a big reserve hardly suspected ten years ago. We know there are large amounts of oil there, but it is expensive to tap.

As we learn more about reef deposits —which are hard to locate by present methods—many more will be brought in. Much more oil is being found in Canada, New Mexico, and other Rocky Mountain areas.

In February of this year, at the annual meeting of the Petroleum Branch of the American Institute of Mining, Metallurgical, and Petroleum Engineers, representatives of The Chase Manhattan Bank presented a survey showing probable United States energy requirements in 1965. The estimated increase were: total energy requirements, up 40 per cent; energy from petroleum, up 55 per cent; from natural gas, up 48 per cent; from coal, up 17 per cent. Interestingly enough, the estimate assumed that atomic energy use would still be quite small.

Except for the figure for coal, which seems to me to be definitely too low in view of the expansion of central power plants, I concur generally with the bank's estimates. Certainly there is no question but that crude oil will be our main source of liquid fuels, not only for the next ten years, but probably for several decades. It will be a major, although probably not exclusive, source much beyond that period. But what is going to happen when the discovery curve finally does flatten out? Where can we then turn for our liquid fuels?

Future Sources of Liquid Fuels

We may rely on several sources. First, of course, petroleum imports will gradually increase. Second, natural gas will be more widely used, and some may be converted to liquids. Our third source of liquid fuel is likely to be oil shale; our fourth, coal; our fifth, tar sands; our sixth, agricultural products; and possibly the last, air, water, and sunlight or atomic energy. Obviously there will be considerable overlapping between many of these sources and the latter ones are many decades or even centuries away. Just as we begin to make liquid fuels from imported crude oil long before our own domestic reserves are exhausted, so other sources will come into the picture gradually as economic conditions and technological developments warrant. The moderately high prices required to bring some of these sources into action will also promote secondary recovery, more conservation in use, and some increase in the use of gaseous and solid fuels, where such use is not too inconvenient.

There is, however, no crisis in sight that would warrant any attempt at end-use or other arbitrary control, as some of our politicians have urged. Imagine what would have happened if end-use control had gone into effect in 1920. The decision might well have been that 20 to 80 was a good ratio between oil and coal production. But if oil production or use had been controlled so that it could be produced only in that ratio to coal, what would have happened to automobiles, trucks, tractors, and the many other gasoline-powered vehicles?

Economic factors are the best determinants as long as we have freedom of enterprise. The various alternatives for obtaining liquid fuels from sources other than domestic crude oil will come into the picture, one after the other, when economic conditions warrant, and they will take their proper place in the economy without aid from any planning agency. Our only worry is that government planning agencies may hinder us.

Suppose we take a somewhat closer look at the various sources I have listed. When shortages develop, we shall almost certainly turn first to increasing imports of crude oil. Since the United States has only six per cent of the world's land area and only 15 per cent of the area reasonably favorable for oil accumulation, we can hardly expect to continue indefinitely our ninety-year record of producing nearly 60 per cent of the world's oil. We have already dropped to about 50 per cent of current free world production, and our proven reserves are today less than 20 per cent of the free world's. While imports at the moment are greater than many of us in the domestic industry like to see, foreign oil fields are bound to increase in production more rapidly than domestic fields from now on. Net imports of crude oil and products have gone from below zero during World War II to an average of around 875,000 barrels per day in 1955. This is more than 11 per cent of domestic production.

Fortunately, the great bulk of all Western Hemisphere reserves and over half of the probable Near East reserves are under American control. In the last ten years, while United States production has increased by 1,900,000 barrels a day, or 42 per cent, Western Hemisphere production outside the United States has increased by 1,800,000 barrels per day, or 145 per cent, and free world Eastern Hemisphere production had gone up 3,200,000 barrels per day, or 490 per cent.

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Venezuela, Canada, Mexico, and the Middle East are going to be increasingly important sources of oil. The richness of some of the Middle East resources is not widely appreciated.

While domestic American wells produce an average of 13 barrels a day, the average production in the Middle East is about 4,800 barrels per well per day. In addition, it took about 120,000 wildcats to discover the amount of reserves and producing fields in this country today. Only 200 or 300 wildcats were necessary to discover the vast amount of oil that his been found in the Middle East.

Non-Petroleum Sources of Liquid Fuels

After imported crude oil, we may turn to natural gas, both as a substitute for and a source of liquid fuels. It is already quite possible to make gasoline from natural gas. But because of the increasing field price of the gas, its fundamental worth for other purposes, and the fact that about half of the energy content is lost in conversion to liquid fuel, it seems likely that the trend will be to use natural gas directly as fuel and to convert fuel oils—rather than gas—into gasoline. However, the chemical by-products of the gas conversion process may justify a few plants. You probably know that we are starting up such a plant at Brownsville, Texas right now. The Fischer-Tropsch method of synthesis yields by-product alcohols, ketones, acids, and the like.

Oil shale will probably come into the picture next. Our deposits of this material are very large. The U. S. Geological Survey has just re-estimated the amount of high-grade shale available. At the present rate of consumption of liquid fuels, the shale deposits of Colorado alone would supply the country's needs for over 300 years!

The Bureau of Mines has done some excellent development work, which shows that mining costs can be brought lower than had been anticipated. This source presents some difficulties, however. Most of the oil shale occurs where water and housing are both scarce. Whole cities would have to be built, and water supplies would have to be developed. Improvements in retorting methods have cut down the water requirements. It now appears feasible to make gasoline from shale at not more than 20 to 40 per cent above present costs. The first use of oil shale will probably be as a source of heavy fuel oil. A certain amount of by-product gasoline and distillate fuel would undoubtedly be marketed locally if there were a demand for the heavy fuel oil at an adequate price.

Coal is another possibility. There are two processes for converting it into liquid fuels. One is gasification followed by the Fischer-Tropsch synthesis. The coal is converted into a mixture of carbon monoxide and hydrogen and then processed in much the same way as gasoline is synthesized from natural gas. The other is the high-pressure hydrogenation process.

The Fischer-Tropsch method now seems the most promising. While the quality of the gasoline made in the early operations was low, work on the natural gas process has shown how quality can be improved by better choice of catalysts and operating conditions. But we must remember, in any discussion of coal as a source of liquid fuels, that if we expect to get the same amount of gasoline from coal as we now get from petroleum, the coal-mining industry will have to be more than doubled! If it becomes necessary to use low-grade coal deposits for this purpose, the industry will have to be nearly trebled. While the deposits are very large, much larger than our proven reserves of petroleum, enlarging the coal indusry by a factor of three would bring many problems.

Canada's tar sands are another possible major source of liquid fuels. But the sand must be mined, the tar extracted and then refined. This refining process presents a big problem. The tar does not contain enough hydrogen to manufacture the products needed, and the refining process itself has not been thoroughly developed. In addition, the industry would have to be located in Canada's far West, which creates some new problems of housing and transportation.

Deriving liquid fuels from agricultural products is another long-range possibility. But we must keep in mind that, despite the politicians, this country cannot afford to use foodstuffs for conversion to gasoline. Even at $1.32 a bushel, which is slightly below the present support price, a gallon of alcohol from corn would cost 68c a gallon—more than six times the present refinery price for gasoline. And its heat content is only 62% of that of gasoline. As a matter of fact, you could afford to pay more for corn to burn under boilers in competition with coal than you could for converting it into alcohol for motor fuel in competition with present-day gasoline. And you would save building all the expensive processing plants.

Today we are making more than half of our alcohol from petroleum and most of the rest from molasses. It is quite unlikely that we shall, in the foreseeable future find it economic to convert corn or other grain into alcohol for liquid fuel. There remain some real possibilities of making alcohol from some agricultural waste, where the gathering cost could be borne by some other main product. But no matter where we get it, alcohol will for many decades be too costly to be used as a motor fuel.

Perhaps the ultimate way of getting gasoline will be to start with a solar or atomic power plant. That power could be used to electrolyze water into hydrogen and oxygen. The hydrogen could be used to reduce carbon dioxide from the air to carbon monoxide, and the hy-

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drogen and carbon monoxide could then be combined to make gasoline. However, we might find that the use of electric storage batteries charged from these sources would be cheaper, though rather too heavy for our present ideas as to cars.

Science and Technology the Real Resource

There is one general answer to this whole question, and indeed to most material problems. Our real future energy resource is not any substance. It is not so many barrels of oil in the ground, or even the nuclei of so many fissionable atoms. Instead, it is science and technology. If we have alert scientists and engineers, and have freedom for them to explore and develop, and if we retain the incentives for industry to put them to work, *there will be no continuing shortage of any product that people really want and need.*

In closing, I might mention some recent items that illustrate another important point. In the new science section of the *Saturday Review*, Harrison Brown of Caltech describes a fascinating game. He and his scientific friends imagine that they have been given the job, about a century ago, of allocating funds for research. If the problem under study had been home lighting, they might reasonably have supported research on candles, on natural gas, and on the migration habits of whales. They could not have justified a grant to Michael Faraday or to the other pioneers whose basic research on electricity was eventually to lead to the electric light.

Important unforeseen results also come from applied research. A good example is polyethylene, the new plastic used for everything from squeeze bottles to garment bags. Is it available because a scientist started out to make a plastic? Not at all. Instead, a chemist —Dr. William M. Burton—along about 1909 wanted to crack heavy oils to make gasoline. The research was successful. The cracking produced, in addition to gasoline, large quantities of by-product gases. At first those gases were simply burned under the refinery boilers. It was only after much basic and applied research that we now use those gases, more than forty years later, for making polyethylene.

Any predictions for the future must take into account the great diversity of science. It may well be that our energy problems will be solved by a scientist now studying electron configurations in silicon, or even some subject considered utterly unrelated to energy.

As engineers, you are practical men, and you are so regarded by your companies. Your advice is needed. You can do no more constructive act than to point out to your organizations the importance and ultimate value of basic research. And if you can help us convince the politicians that freedom of research and enterprise is the real essential of continued progress, we may rest confident that *engineering will not be stymied during the foreseeable future by any lack of energy sources*, even though we cannot foresee with certainty exactly what they will be at a given time.

A Thought

He that hath no Ill-Fortune will be troubled with Good.

—Poor Richard's Almanack

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Acoustics Congress Set for June 17-23

More than 500 of the world's leading authorities on sound and noise control will take part in the second International Congress on Acoustics in Cambridge, Mass., from June 17 through 23.

Harvard University and the Massachusetts Institute of Technology will be joint hosts for the international meeting. The sessions will be held in conjunction with the 51st meeting of the Acoustical Society of America, a member society of the American Institute of Physics.

The combination will make this the largest technical meeting on acoustics in history. Over 100 technical contributions have been received from abroad; they will be presented by scientists from Argentina, Belgium, Canada, Denmark, Great Britain, France, Germany, Hungary, India, Italy, Japan, The Netherlands, Norway, Soviet Union, Saar, Sweden, and Turkey.

The international meeting is sponsored by the International Commission on Acoustics, which is part of the International Union of Pure and Allied Physics. The first such Congress was held in Delft, Netherlands, in 1953.

The technical program for the Congress will be organized around three major symposia:

Bioacoustics and noise control—human responses to sound (including hearing, psychological response, and biological effects) and noise control methods based on these responses.

Architectural and musical acoustics—the production of music and speech sounds and the design of enclosures for good hearing conditions.

Physical acoustics and sonics—acoustical studies of matter, propagation of sound, and application of acoustical techniques to technical problems.

There will be special demonstrations of speech analysis and synthesis. Special exhibits will be prepared for the Congress by many scientific, technical, and manufacturing concerns throughout the world.

The Congress will open with an international reception on Sunday evening, June 17, and an international convocation Monday morning. Technical sessions will continue all week with a closing banquet on Friday evening, June 22.

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C-4963 METALLURGICAL ENGR. BS. 2 yrs. exp. in metallurgy. Duties: perform research & dev. work in the area of ore dressing. For Research. Sal: $450-600. Location: Chicago. Employer will pay the fee.

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CRERAR LIBRARY
News and Notes

The summer schedule of Library hours is in effect from June 18 through Labor day, September 3. Reading rooms are open for service Monday through Friday only, 9:30 a.m. to 5:30 p.m. After Labor Day, Saturday and Monday night openings will be resumed.

* * *

The month of June brings with it the annual conferences of various library groups, at which Crerar is represented whenever possible. The Librarian attended meetings of the Special Libraries Association in Pittsburgh during the week of June 4. Recruitment of personnel, discussions concerning the Translation Pool operated for SLA by Crerar, and numerous other items of professional interest were touched upon. In Miami Beach, the American Library Association was to meet on June 18, with the Associate Librarian in attendance. On his agenda were meetings of the Association of Research Libraries, the advisory group of librarians for the Midwest Inter-library Center, and various functions of the Association of College and Reference Libraries.

On May 13, the Librarian attended a meeting of the Visiting Committee on the Library of Massachusetts Institute of Technology. The Committee, composed of industrialists and educators, provides consultation and advice on the objectives and services of the Library to the Institute and to industry.

New Control Concepts Much Affect Industry

New concepts of instrumentation control are having profound influence on industry, Dr. John J. Grebe, director, Basic and Nuclear Research Department, Dow Chemical Company, said in Boston on Apr. 26.

Three types of controls that may be coupled together to provide complex information quickly and accurately are the mass spectrometer, the digitalizer and the digital computer, Dr. Grebe told the National Technical Conference on New Developments in Instrumentation for Industrial Control, sponsored by the American Institute of Electrical Engineers. Dr. Grebe was the principal speaker at a banquet in the Hotel Bradford.

"In order to study some of the instruments that are having the profoundest effects on research now and may soon have on your industry," Dr. Grebe said, "let us consider three types that may be coupled together very advantageously:

"First—A mass spectrometer which is characteristic of a whole class of what might be called analytical machines.

"Second—A 'digitalizer' which will take continuous potential type readings, such as from a thermocouple or from a strain gage type of instrument; transform such readings to digital form and record it on a punched card, or a punched tape.

"Third—A data processing machine such as a digital computer which will receive such punched information, calculate the answers desired from the data and print reports containing them.

"Consider the possibilities of such a team. In 15 minutes the mass spectrometer can analyze a complex organic mixture for as many as 30 or more components. The 'digitizer' records data as fast as the mass spec evolves it. A small to medium sized computer can calculate the data in one or two minutes."

Dr. Grebe, whose address was titled "Horizons in Instrumentation," said that the greatest source of specific new technology for measurement and control has to do with radioactive isotopes.

"It is just wonderful to be able to put tracer quantities into great streams of materials in process and find out that there are millions of atoms in this quantity that explode regularly, exactly in proportion to the number of them present, and burst out in an exultant shout and tell you—'I'm here. It is I. It is little Gene—no, not Tom, it is Gene,' and from that you can deduct all sorts of conditions such as time intervals, numbers, acidity, turbidity, concentration, level, rate of acceleration, thickness, depth, height, accumulated inventory, velocity and what-not."

Control engineers, he said, should not think of themselves as simply men who improve the material output of factories and power sources, but as people capable by long training and association of dealing with "variations in all the concepts and aspects of life, matter and energy in all natural phenomena and human endeavors.

"This is the breadth of interest that can make your life really worth living. It will make your youngsters recognize that you are facing the problems of life on all fronts. It will find you a place on the councils of men. It can give you the feeling that you are functioning in cooperation and unison with all of nature and its Creator.

"The newest field of instrumentation engineering is the perfection of new technology for measuring new properties that so far have been left to analytical and research procedures. This would not only put existing processes and products under better control, but would give more courage to try to control many of the things that are still being left to chance, mob psychology, and emotions."

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On Ceremony

A man without ceremony has need of great merit in its place.

—Poor Richards Almanack

Reviews of Technical Books

Hi-Fi Loudspeakers And Enclosures

Hi-Fi Loudspeakers and Enclosures, by Abraham B. Cohen, John F. Rider Publisher, Inc., New York 13, N. Y. 1956. 368 pages, paper covered. Price $4.60.

A long-awaited book written for the hi-fi enthusiast, as well as the audio technician; innumerable questions, which pertain to high-fidelity loudspeakers and enclosures, are answered from a practical point of view.

Cohen is both a musician and an engineer. He has long been closely connected with the field of acoustics, and especially loudspeaker and enclosure design. He states that high fidelity is an art, and so it cannot be aptly defined. He keeps in mind individual problems, as he traces the gradual steps from basic loudspeaker principles toward an understanding of the variations used in specialized high quality reproducers.

The material is presented for the man who wants to assemble his own hi-fi system from separate units, or for the man who is interested in pre-assembled systems, in a conclusive, well-illustrated manual.

In the first three principal sections, *The Loudspeaker* is discussed in detail. Easy steps in basic loudspeaker principles leading to an appreciation of specialized high efficiency in quality reproducers; explanation of terms, for example, speaker resonance, impedance, and dumping; multi-speaker design information; and charts and graphs that help the hobbyist to construct his own networks are all included.

The second division, *The Enclosure*, analyzes and develops types of loudspeaker baffles and enclosures from the simplest flat baffle to the most complex folded horn enclosures.

The Room is the last division and deals with the listening room as part of the acoustic circuit and includes information on enclosure placement and room treatment and adjustment for best hi-fi reproduction.

An added feature is the appendix; in this there are 18 complete plans for the construction of typical loudspeaker enclosures of all types and for various speaker sizes.

Abraham B. Cohen is engineering manager of University Loudspeakers, Inc. He is a graduate of Northeastern University. Not only was he first violinist in the Boston Civic Symphony Orchestra, but for many years he was studio control engineer at WCAU in Philadelphia and subsequently master control engineer for station KYW. He has done graduate work in mathematics and acoustics at the University of Pennsylvania, and he holds patents on two loudspeakers.

R.G.G.

Construction Planning

Construction Planning, Equipment, and Methods, by R. L. Peurifoy, McGraw-Hill Book Company, Inc., New York 36, N. Y. 1956. 534 pages. Price $8.50.

Written in the hope that the information presented will demonstrate that engineering analyses may be applied to construction, the subject is treated on an engineering basis, but the discussions can be understood by those who have had vocational training.

Peurifoy mentions that years ago successful construction depended on one's ability to drive men, mules, and equipment in order to maintain a progress schedule and complete a project at the lowest possible cost. The modern method is to carefully plan each step for a project before construction is begun. But there is a need for the application of even more engineering knowledge.

So he provides text material dealing with construction for students in engineering, architecture, and related fields. Then he furnishes a guide to assist professional men in the construction industry in project planning, suggesting the most suitable equipment and methods for each project. Also included, for professional engineers and architects, is a guide to follow when designing projects and writing specifications so that the most satisfactory and economical methods will be used. For Peurifoy states that if a project can be constructed equally well by either of two methods, or by either of two pieces of equipment, that method or that equipment which will construct the project at the lower cost usually is considered more suitable.

For the manufacturers, distributors, and users of construction equipment bases for analyzing the performance, cost, and suitability of various types of construction equipment are given.

Some of the special topics of considerable value, which have not been thoroughly explained in other books of this kind, deal with the methods of analyzing problems so that a correct solution is more easily attained. Construction stages and job layout; record-keeping of equipment performance; material costs, and labor costs; engineering fundamentals applied to construction; how to select the most suitable types of earth moving equipment; and suggestions for reducing the cost of excavating and transporting earth, are examples of the presentation of practical and useful information. All 20 chapters are well-illustrated; tables, problems, and examples add to the merits of this book.

R. L. Peurifoy is professor of construction engineering at the Agricultural and Mechanical College of Texas. He has long been active in the civil enginering field, for the most part serving as an engineering professor. He has also written *Estimating Construction Costs.*

R.G.G.

Atoms vs. the Insurance Industry

The peacetime use of atomic energy poses many new and serious problems to the insurance industry, Charles R. Williams, director of industrial hygiene services for Liberty Mutual Insurance Company told members of the American Industrial Hygiene Association meeting in Philadelphia recently.

These problems are twofold, Williams said. Firstly, to underwrite insurance coverage for the numerous power and research reactors now being constructed; secondly, to provide a safe environment for employees handling nuclear materials, and for the surrounding community.

Because of the wide discrepancy in the amount of public liability insurance which the industry feels it needs, and the maximum limits which insurance carriers can provide, Williams said that the first problem is still unresolved.

Industrial hygienists will have many important contributions to make toward the design and safe operation of nuclear reactors, Williams predicted. In this respect they will be responsible for air sampling, monitoring, personal protection, ventilating design and maintenance, control of atmospheric and liquid wastes, and handling and storage of fuel.

Williams warned that industries contemplating the construction of nuclear reactors have a public relations problem which must be solved if they are to secure community acceptance. He noted that since atomic energy is generally associated in the public mind with the destructive forces of nuclear weapons, industry's relations with both the public and labor is extremely critical. He pointed out that there have already been cases where the failure of some companies to inform both groups in detail prior to embarking on atomic energy projects has resulted in spirited and in some instances successful opposition.

On the other hand, the companies which openly discussed their plans with public officials and with the public through the newspapers have had little or no difficulty, he said.

In addition to a public information program, Williams warned that management should also give employees a frank appraisal of the potential hazards involved, inform them of the safeguards being taken for their protection, and then train them to do their work safely and effectively.

Since a major failure of a reactor is always a possibility, disaster plans including evacuation, treatment of injured, and decontamination procedures will also have to be set up. Failure to take such a precaution, Williams stressed, could lead to chaos, panic, and increased damage in the event of an accident.

Williams said that while the more spectacular forms of atomic energy in nuclear reactors had been given public attention, a parallel expansion in the use of radioactive materials was developing in industry and medicine. This greatly increases the number of people coming in contact with radiation, as well as substantially increasing the amounts of radioactivity and the energies involved.

Williams said that the quality of personnel selected to work with atomic energy processes is of paramount importance, since practically all incidents so far have been the result of human error.

The legal responsibility of private industry for injury or damage caused by nuclear materials stems from the Atomic Energy Act of 1954, Williams said in reviewing the medical and industrial background of radiation. Prior to that the Federal government assumed all responsibility. Earlier sources of radiation, dating back to 1912, were of non-nuclear origin and presented no major safety problem.

Williams said that during the normal operation of a reactor there are no serious safety problems. However, each of the four types of reactors—research, nuclear power, materials testing, and propulsion—present different degrees of potential hazard to both operating personnel and the public generally.

For example, Williams said that research reactors, because of their small size, probably create a limited hazard to the public. On the other hand, due to the diversity of research projects and the number of operating personnel involved, this type of reactor will require constant supervision.

Reactors for power, although having inherently large capacities for destruction and contamination, are not so apt to fail as the smaller research reactor. The reason for this is that power reactors will be operated on a routine basis and with a permanent staff, whereas research reactor staffs will change from one project to another.

Development of material testing reactors, whose function is to determine the suitability of materials used in constructing power reactors, and of propulsion reactors, is still under the control of the Atomic Energy Commission, Williams stated.

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Wood Said to Last Thousands of Years

The longevity of wood must be measured in thousands of years, reports the National Lumber Manufacturers Association. Wood models and figurines 6,000 years old have been found by archeologists in the tombs of ancient Egypt. In fact, glued wood panels were interred with the body of King Tut, according to archeological discoveries. Most historians agree that the oldest wooden building in the world today is the 1,349-year-old Horyuji Temple at Kyoto, Japan.

WSE Personals

Ceremonies honoring Colonel A. W. Sikes, MWSE, on his retirement from the U. S. Army Reserve, were held recently at the Cicero Armory. He has a service record of 32 years and holds victory medals for participation in both World War I and II, and numerous other decorations for war and reserve service.

Colonel Sikes has held continuous membership in WSE since 1931 and served as chairman of the Chemical and Metallurgical Section in 1940. He also belongs to various other technical societies and is now employed as specification engineer for the Chicago Park District.

* * *

Alois W. Graf, Leonard G. Nierman, and Marshall A. Burmeister announce the formation of the firm of Graf, Nierman & Burmeister for the practice of law, specializing in patents, trade-marks, and copyrights, with offices at Suite 1165 Board of Trade Building, Chicago 4. Their telephone number is WAbash 2-3266.

* * *

The appointment of Ernest R. Hendrickson, MWSE, as manager of construction for Commonwealth Edison Company and its Public Service Company Division, has been announced by Willis Gale, chairman.

Hendrickson, who formerly served as manager of construction for Public Service Company, most recently held the post of assistant manager of engineering for Commonwealth. He was with the Edison-Public Service system from 1924. He succeeded John F. Sullivan, Jr., past-president of WSE, who left the utility to become president of Asbestos & Magnesia Materials Company. Sullivan had been with Edison since 1925.

* * *

Al Gross, formerly vice president of Royalcall, Inc., Cleveland, has been appointed chief engineer of Cleveland Metal Specialties Company, it was announced by Roger Middlekauff, president.

The designer of the "walkie-talkie" which came to prominence through World War II use, Gross will be in charge of the design and development of new products and of technical services to customers.

During the war, Gross was associated with the Proximity Fuse Program, and one of his later developments was the Citizens' Band Walkie Talkie which is manufactured today by the Stewart Warner Corporation under the name of "Portaphone."

Long an exponent of printed wiring, he has published papers on miniaturization of circuits and printed circuit techniques.

Gross is a senior member of the Institute of Radio Engineers, and was formerly chairman of the Cleveland Chapter of the Armed Forces Communications Association.

* * *

John A. Logan, professor of civil engineering at the Northwestern Technological Institute, has been named associate director of the new Transportation Center at Northwestern University.

His appointment was announced by Franklin M. Kreml, director of the center. He said Logan will supervise the center's educational, research, and other operational activities.

The center is the only one of its kind in America. It was established by the Northwestern board of trustees in 1954 and will begin operations this fall.

It will utilize all relevant resources of the university for research, undergraduate training, and graduate study in the highway, rail, air, pipeline, and water divisions of the transportation industry. Its headquarters are at 1818 Hinman ave., Evanston.

Logan said he accepted the staff appointment "after much deliberation and because of my conviction that the center will make important contributions to solving major problems of the nation's transportation industry."

Logan, now a member of the faculty committee for the center, will continue to hold the rank of professor of civil engineering. Two assistant directors, yet to be appointed, will respectively have responsibility for education and research under his direction.

Prior to joining the Northwestern faculty in 1954, Logan had been a member of the Rockefeller foundation staff since 1946. He served in the U. S. Army from 1943 to 1946 and previously was an engineer in private industry. He also has taught at the University of Missouri and Iowa State College.

A native of Canada, he received his undergraduate education at the University of Saskatchewan. He obtained his master of science and doctor of science degrees at Harvard University.

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U. S. Industry Gets European Articles

The best articles from European technical and industrial journals, translated and digested, are now available monthly to American industry, John C. Green, director, Office of Technical Services, U. S. Department of Commerce, has announced.

The Organization for European Economic Cooperation, a multi-government agency set up to stimulate economic growth of member-nations, will distribute its monthly publication "Technical Digests" in the United States. It is designed primarily for those interested in manufacturing and production.

Many of the articles in the periodical, which averages 140 illustrated pages, discuss new products and processes developed by European manufacturers. Designed for clear, concise, easy reading, the magazine contains digests of only the most effective articles gleaned by specialists from over 1,000 European periodicals.

The Department of Commerce through its Office of Technical Services is cooperating with O.E.E.C. in making this new source of information known to American industry. O.T.S. for years has served as a clearinghouse to collect reports of U. S. Government research and disseminate them to industry, and issues monthly publications which describe these reports. The O.E.E.C. "Technical Digests" in many respects parallels O.T.S. publications.

Almost all fields of industrial interest are covered in the "Technical Digests" —ceramics and glass; chemicals; corrosion, protective coatings, finishing processes; electrical engineering and equipment; food and allied products; fuel, power, and lubricants; leather; materials handling; metallurgy, metal working, machine shop; packaging and packing; safety; structural engineering; building; textiles; timber and wood; transport; and many others.

The first issue includes articles on an improved paper cup, a new knife for stripping insulation, design and application of a micro "stop" motor, a new instrument for perspective drawing, two additional uses for steel strapping, a novel pipe coupling, and a new shrinking machine for woolen fabric.

Subscriptions are handled by the O.E.E.C. Publications Office, 2000 P Street, N. W., Washington 6.

Research Is Called Air-Pollution Answer

Research, not legislation, is the basic answer to the problem of air pollution.

This opinion was expressed Mar. 22 by W. L. Faith, vice-president and chief engineer of the Air Pollution Foundation, Los Angeles.

He spoke at the air pollution session of the 18th annual American Power conference, sponsored by Illinois Institute of Technology, at the Hotel Sherman in Chicago.

Faith warned that unless legislation is based "on knowledge of the facts," the harm done my override any good that will result.

"For instance," he stated, "you can solve the air pollution problems from power plants by denying permission to operate them, but our economy would be wrecked by so doing.

"Among the by-products of the technology that has brought us comfort and leisure is air pollution. Obviously, the logical approach toward solving the problem must be by ascertaining the facts and developing the remedies—in broad terms, research."

He added that the greatest quantities of contaminants in the air are the result of incomplete combustion or use of imperfect fuels, for which the entire community is responsible.

"Roughly half of the fuel burned in large communities is burned in transportation equipment, private homes, and other nonindustrial units," he explained.

"As a general rule industrial installations are more efficient than nonindustrial, so that more than half of the pollution reaching the atmosphere usually comes from nonindustrial sources."

Faith divided air pollution research into four categories:

—Chemical, physical, and meteorological aspects.

—Health aspects of air pollution, including damage of vegetation.

—Identification and measurement of emissions at the source.

—Development of abatement methods.

Concerning the responsibilities of the various segments of society for air pollution research, he proposed that:

—Local government should determine the rate and type of emissions of air pollutants from local sources and monitor the atmosphere for important contaminants.

—Federal and state governments should share responsibilities for determining the relationship between air pollution and public health, the maximum allowable concentrations of air pollutants under various atmospheric conditions, and the nature of air pollution problems that transcend local, state, or national boundaries or affect general agricultural pursuits.

—Industry should determine the nature of its emissions, develop control devices, improve its fuels and combustion equipment, and support community programs directed toward a solution of the air pollution program beyond its own gates.

Fresh-Water Variety

The standard of living in the United States means consumption of 1,500 tons of fresh water per year per citizen, *Electrical World* reports.

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WSE Applications

In accordance with the By-Laws of the Western Society of Engineers, the following names of applicants are being submitted to the Admissions committee for examination as to their qualifications for admission to membership into the Society in the various grades, i.e., Student, Associate, Member, Affiliate, etc. All applicants must meet the highest standards of character and professionalism in order to qualify for admissions, and each member of the Society should be alert to his responsibility to assist the Admissions committee in establishing that these standards are met. Any member of the Society, therefore, who has information relative to the qualifications or fitness of any of the applicants listed below, should inform the Secretary's office. The Secretary's office is located at 84 East Randolph Street. The telephone number is RAndolph 6-1736.

67-55 Kenneth C. Hudson, Design & Detailing Engineer, Industrial Crane & Hoist Corp., 1536 S. Paulina St.

68-55 Edward O. Meacham, E. O. Meacham Engineering Co., 3512 S. Michigan Av.

69-55 O. Gressens, Chairman Finance Committee, Peabody Coal Company, Prudential Building.

70-55 Jacques H. Bertrand, Division Plant Engineer, Canadian Car & Foundry Co., Ltd., Steel Foundry Div., 5227 N. Dame St., E., Montreal, Quebec.

71-55 Benjamin Hernandez, Civil Engineer II, State of Illinois Division of Highways, 160 N. LaSalle St.

72-55 Fred H. Lindenau, Struct'l & Mech'l Engineer, John F. Meissner Engineers, 308 W. Washington St.

73-55 Wm. A. Stellwagen, R. E. Broker, George S. Lurie Co., 120 S. LaSalle St.

Sub Uses Plywood

Hardwood plywood had a part in construction of the nation's newest atomic-powered submarine, the USS *Seawolf*, reports the National Lumber Manufacturers Association. It was used to make precision patterns of rudders, diving planes and other integral parts of the sub. Hardwood plywood was chosen because of its hardness and stability and because it can be precisely machined.

Space Vehicle to be Discussed at MIT

The flight of the world's first space vehicle, scheduled for the International Geophysical Year 1957, will be one of the topics considered during the 1956 Summer Session at the Massachusetts Institute of Technology.

Plans for an intensive Special Summer Program on Orbital and Satellite Vehicles from August 6 through August 17, 1956, to review the legion of problems facing designers in this field have been announced by Professor Ernest H. Huntress, director of the M.I.T. summer session.

The Program will be directed by Paul E. Sandorff, associate professor of aeronautical engineering; its purpose will be to provide an overall assessment of the technology of orbital vehicles of the present.

In fulfilling this purpose, says Professor Sandorff, the program will review the various fields of science which are involved, the technical problems which must be met, the engineering methods that are available, the unknowns which must be defined, the trends in the development of the arts and of the products, and the probable future applications.

"The technology which is now grappling with hardware design for space vehicles," points out Professor Sandorff, "is a by-product of the long range missile industry. While there are consequently many areas of high security classification," he continues, "there is nevertheless a broad background of engineering and scientific information of an unclassified nature. This Program will present such material."

Lectures and seminars will include the following topics: environmental conditions in upper atmosphere and space; lunar and interplanetary flight; the astronomer's contribution to the background data for space travel; design of rocket powered vehicles; effect of configuration on performance; field experience with high-altitude rockets; recent rocket engine developments; new propulsion possibilities; the ion gun, force ray, "anti-gravity"; guidance and control of orbital flight; re-entry: the aerothermal problem; applications and instrumentation of unmanned space vehicles; and man-into-space: the physiological and engineering aspects of providing for man in space.

Registrants for this Special Summer Program may reserve rooms in the Institute's dormitories during the Program. All M.I.T. recreational facilities, including the swimming pool and the popular sailing pavilion on the Charles River Basin, are available for their use.

Full details and application blanks may be obtained from the Summer Session Office, Room 7-103, Massachusetts Institute of Technology, Cambridge 39.

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Apartment Building Will Have 480 Volts

Electrical capacity to accommodate air conditioners, electric ranges, clothes dryers and other heavy duty appliances will soon be available throughout a 28-story 100-apartment building at 5000 East End ave., in Chicago as a result of a rewiring project now nearing completion.

Under an arrangement worked out by the owners and Commonwealth Edison Company, the building's central wiring is being increased to 480 volts. The conversion will enable all occupants of the co-operatively owned building to get 240-volt service as well as their present 120 volts.

Using the building's existing wiring system, capacity is increased by installing a 480 volt 3-phase distribution transformer to serve the building. Inside dry type transformers, installed and maintained by Commonwealth Edison, are used to step down the voltage to normal residential requirements of 120 and 240 volts.

According to Commonwealth this rewiring method is especially suitable to elevator-type buildings 10 or more stories high.

J. A. Holmes, president of the 5000 East End directors, reports that the $250 per apartment cost of the project is considered a worthwhile investment by tenants who are looking forward to enjoying a standard of electrical living that compares to the best-wired houses.

Ordinarily electrical capacity is improved by increasing the number and size of electrical feeders. This involves more extensive construction work because floors and walls must be opened and heavy conduits, cables and large pull boxes must be installed.

The Edison Company presently is working on plans to make this latter type of wiring modernization less costly for owners of buildings smaller than the 5000 East End.

It is pointed out that approximately 70 per cent of the population of the city of Chicago is housed in 187,000 apartment buildings. Most of these buildings were constructed before 1935. As a result, they are equipped with inadequate electrical systems that cannot supply power for the electrical appliances desired by modern-minded tenants.

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Diamonds Important to Automation

Automation was cited in Chicago on Mar. 21 as one of the principal reasons for the increased use of diamond tools by industry.

"The irresistible advance of automation has put a new emphasis on continuity of production," pointed out Joseph Klipper, vice president and general manager of Clipper Diamond Tool company.

"The more automatic a process becomes, the more it costs to shut down. So, to get the real advantages of automation, you must somehow manage to machine more pieces than ever before, between tool replacements and tool adjustments."

Klipper spoke at the morning session of the Symposium on Shaped Diamond Tools, co-sponsored by Armour Research Foundation of Illinois Institute of Technology and the American Society of Tool Engineers.

The symposium was one of the highlights of the ASTE's 24th annual convention and industrial exposition at the International Amphitheatre.

In addition to automation, Klipper listed three other factors in the growing utilization of industrial diamonds in tools:

—The need to maintain closer tolerances.

—The need for cutting tools which will stand up under the extreme abrasive effect of new materials.

—More people are learning how to use diamonds.

He said diamonds will never replace high-speed and carbide tools in industry, but that there are "countless jobs now being done by conventional tools which diamond tools could, and eventually will, do better."

"They are jobs that demand low tolerances and high finishes, where precision is essential, and where high production schedules must be maintained over considerable periods with a minimum of down-time for tool replacement."

In another paper presented Mar. 21 at the diamond symposium, L. A. Hurwitz and R. A. Kurtz of Hamilton Watch company's science laboratories told of the superior wear resistance of diamond tools.

"Production figures reveal that wear resistance of the diamond tool cutting edge surpasses that of high-speed tools by a factor of 20 or 30 to 1, and carbide tools by a factor of 3 or 4 to 1," they explained.

In several cases, they added, diamond tools have been in use for a year or longer, and over 100,000 pieces of work were finished before resharpening the diamond.

"While the cost of the diamond tool was high, the cost per part was lower than could have been expected with steel or sintered carbide tools."

AIEE Approves New Major Division

Because of the increased importance of instrumentation in electrical engineering, a sixth major technical division of the American Institute of Electrical Engineers, to be known as the Instrumentation Division, has been approved by the Board of Directors, N. S. Hibshman, institute secretary, has announced.

The new division, of which C. F. Savage, Jr., General Electric Company, New York, has been named chairman, will begin operations as a division Aug. 1. At present it is part of the Science and Electronics Division, and is known as the Committee on Instruments and Measurements.

Present subcommittees on indicating and integrating instruments, recording and controlling instruments, electronic and high frequency instruments, special instruments and auxiliary apparatus, telemetering, nucleonic and radiation instruments and navigation instruments, will become committees under the new set-up.

Other Technical Divisions of the Institute are those on Communications, General Applications, Industry, and Power.

Chicago to Have Largest Atom Station

Dresden Nuclear Power Station, which is to be owned and operated by Commonwealth Edison Company in cooperation with Nuclear Power Group, Inc., will be constructed 47 miles southwest of Chicago at the point where the Des Plaines and Kankakee rivers meet to form the Illinois River.

The station, which is to have capacity of 180,000 kilowatts, is the largest all-nuclear power plant yet scheduled in the country. The plant will be of the boiling water reactor type which was developed by Argonne National Laboratory.

The station is to be built by General Electric Company at a cost of $45,000,000. Commonwealth Edison will pay $30,000,000 of this price plus the cost of the site and overhead costs. The remainder of $15,000,000 is to be paid as a research and development expense by the eight companies comprising Nuclear Power Group.

These companies in addition to Commonwealth Edison are American Gas and Electric Service Corporation, Bechtel Corporation, Central Illinois Light Company, Illinois Power Company, Kansas City Power & Light Company, Pacific Gas and Electric Company, and Union Electric Company of Missouri.

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Interior view of Underground Garage

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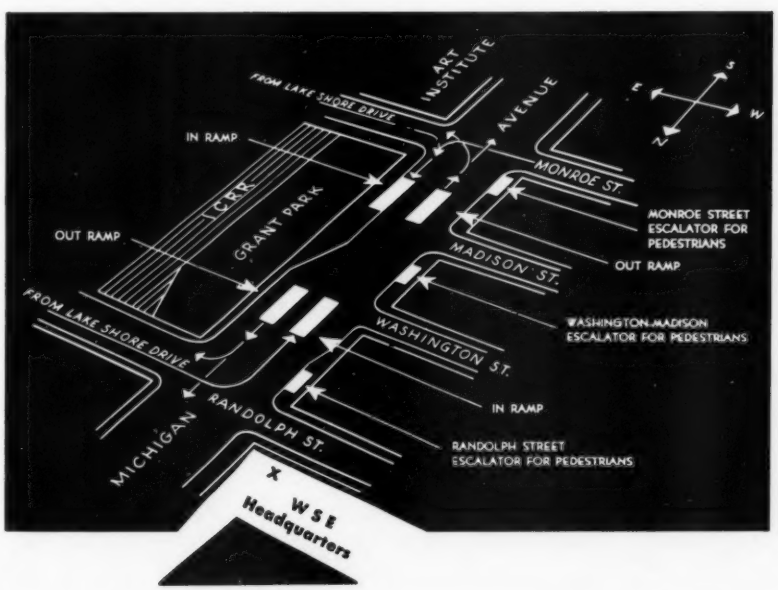
Below: map showing Park Department Underground Garage



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Engineering News from Commonwealth Edison

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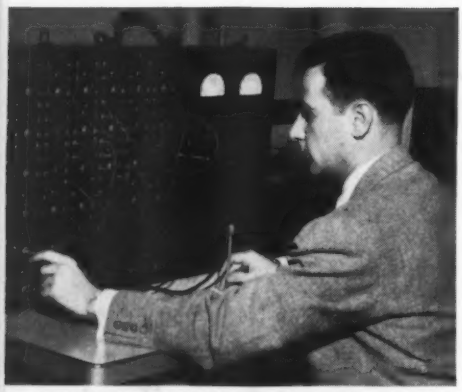

Gerald Stropoli at work on his present Graduate Training Program assignment, one of 7 he has already had during his first year. He is shown working on a transmission problem using a small calculating board.

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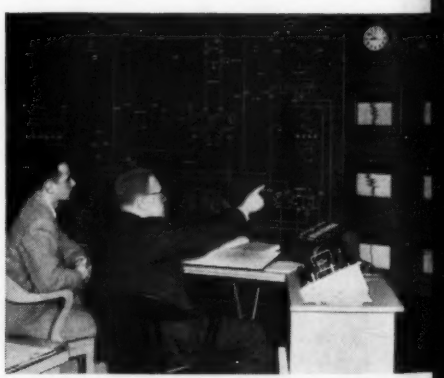
The Electronics Laboratory. Gerald is shown making tests on some of our communications equipment.



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